IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application of:	ESLAMY, Mohammad	Confirmation No.:	9873
Serial No.:	09/938,075	Art Unit:	2815
Filed:	August 23, 2001	Examiner:	Joseph H. Nguyen
For:	*Symmetric Stack Up Structure for Organic BGA Chip Carriers*	Attorney Docket No:	060889-0055 **(formerly 9818-0055-999)**

BRIEF ON APPEAL BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Commissioner for Patents
Mail Stop AF
P. O. Box 1450
Alexandria, VA 22313-1450

Sirs:

(1) Real Party in Interest

The real party in interest is Altera Corporation

(2) Related Appeals and Interferences

There are no related appeals or interferences.

(3) Status of Claims

Claims 9-15 and 20 are pending and appealed. Claims 1-8 have been cancelled without prejudice. Claims 16-19 are directed to a non-elected invention and have been withdrawn from consideration.

(4) Status of Amendments

On July 31, 2003, a response was filed to a final rejection. No changes to the claims or specification were made in that response.

(5) Summary of the Invention

The present invention includes a semiconductor chip carrier 30 having a stack-up structure comprising a primary substrate 32, a metal heat sink plate 34, and a supplemental substrate 50, as described at page 3, line 23 to page 4, line 13 and as shown in FIGS. 1 and 2 of the application. Fig. 1 of the application is reproduced below.

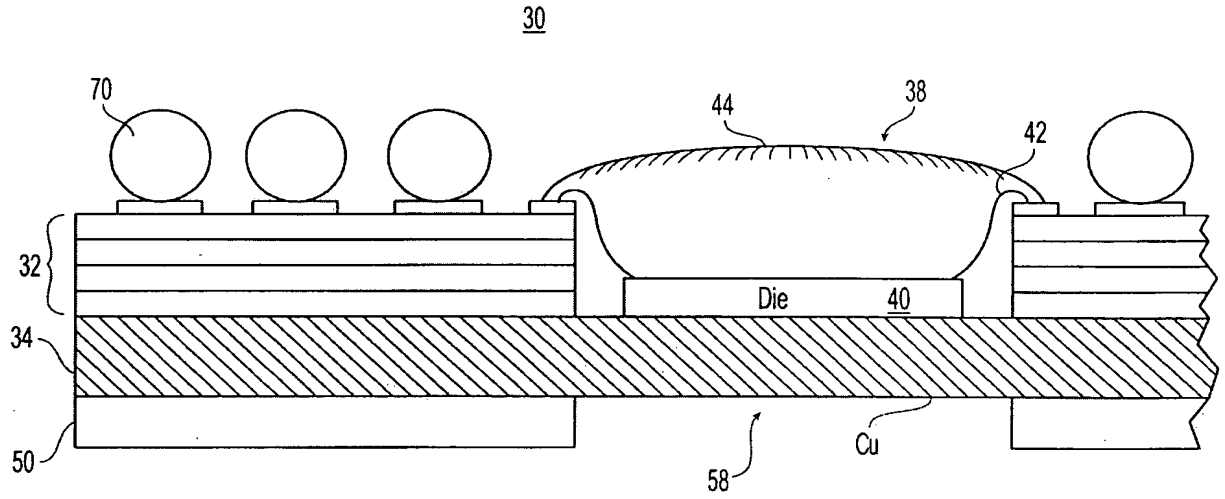


Fig. 1

The primary substrate is attached to one side of the metal heat sink plate and the supplemental substrate is attached to an opposing side of the metal heat sink plate. The metal heat sink has a coefficient of thermal expansion (CTE) substantially different from that of the primary substrate, while the supplemental substrate has a CTE substantially similar to that of the primary substrate. Thus, the present invention utilizes the supplemental substrate to create a symmetry in the stack-up structure, so that the bending force resulting from the mismatch of coefficients of thermal expansion between the primary substrate and the metal heat sink plate can be counterbalanced by the presence of the supplemental substrate (p. 4, line 1-13). Therefore, this invention provides a solution to the chip-carrier warping problem where the CTE of the metal heat sink plate does not match that of the primary substrate.

As shown in the embodiment of Fig. 1, primary substrate 32 has a hole that forms a die-attach cavity 38 within which semiconductor die 40 is attached to the metal heat sink plate. The die is electrically connected to the primary substrate by bonding wires 42.

Internal wiring within the primary substrate completes the electrical circuit from the die through the bonding wires to solder balls 70.

(6) Issues

The issues presented for review are:

a. Whether Claims 9-15 were properly rejected under 35 U.S.C. 103(a) as being unpatentable over Johnson et al. (US 6,288,900 B1), in view of Shishido et al. (US 6,294,831 B1); and

b. Whether Claim 20 was properly rejected under 35 U.S.C. 103(a) as being unpatentable over Johnson et al., and Shishido et al. as applied to claim 9 in further view of Hamzehdoost et al. (US 5,491,362).

(7) Grouping of Claims

Claims 9-15 and 20 do not stand or fall together. Claim 10 is directed to a specific structural embodiment distinct from Claim 9. Claim 20 has been separately rejected.

(8) Argument

(a) Claims 9 and 11-15

Claim 9 claims a semiconductor chip carrier comprising a primary substrate, a metal heat sink plate, whose CTE is substantially different from that of the primary substrate, and a supplemental substrate. The metal heat sink plate has a first side and an opposing second side and the primary substrate is attached to said first side and the supplemental substrate is attached to said second side so that the metal heat sink plate is between the primary substrate and the supplemental substrate. In addition, the supplemental substrate is constructed from a material having a substantially similar coefficient of thermal expansion as that of said primary substrate so that the presence of the supplemental substrate prevents the semiconductor chip carrier from warping.

Johnson and Shishido do not teach or suggest the claimed subject matter. As shown in Fig. 6 of Johnson, which is reproduced below, Johnson discloses an electronic circuit module comprising a substrate 12 upon which a chip 14 is mounted, and a heat spreader cap 22 mounted on an encapsulant 24 over the substrate 12 in order to dissipate heat and counter-balance the forces exerted by the thermal mismatch between the chip 14 and the substrate 12. To achieve the counter-balancing function, the heat spreader cap 22 in Johnson includes a midsection and a peripheral section and comprises two different materials 28 and 29, with material 28 sitting between material 29 and the encapsulant 24 (col. 3, lines 33-36, and lines 40-41; Col. 4, lines 7-12). Johnson does not, however, disclose what materials 28 and 29 are.

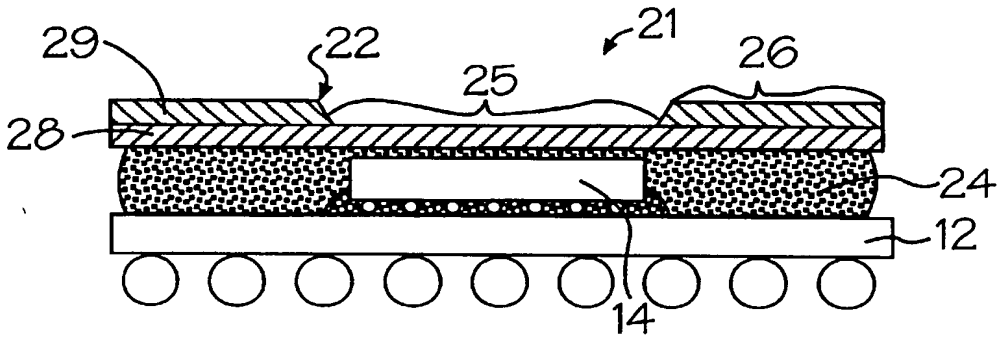
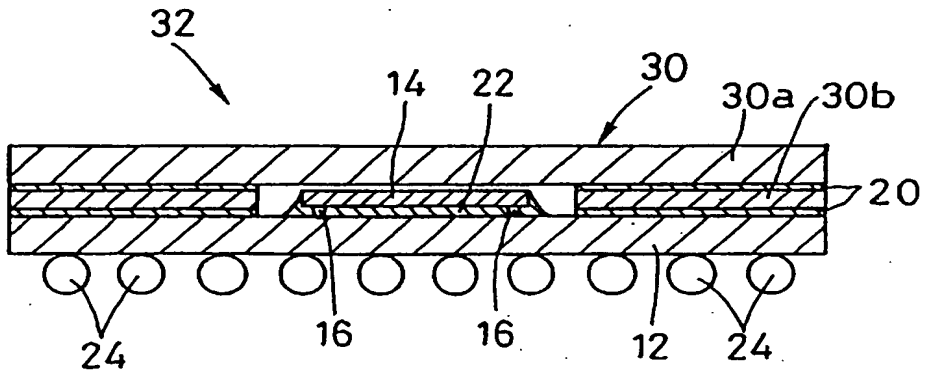


Figure 6

As shown in Fig. 2 of Shishido, which is reproduced below, Shishido discloses an electronic package comprising an organic substrate 12, a semiconductor chip 14 on a first surface of the organic substrate, and a thermally conductive structure 30a and 30b bonded to the substrate, wherein the thermally conductive structure is of a different material from the substrate while having substantially the same CTE as the substrate.

FIG. 2



The Examiner rejected applicant's claim 9, arguing that it is obvious to combine Johnson and Shishido by replacing part of Johnson's heat spreader cap 22, i.e., the upper material 29, with Shishido's thermally conductive structure 30a that has substantially the same CTE as the substrate. This would result in a structure such as that in Figure 6 of Johnson (shown above) except that layer 29 of the heat spreader cap 22 would have a CTE substantially the same as that of the substrate 12.

The Examiner's rejection is improper for several reasons. First, Johnson and Shishido are prior art in a different field of endeavor and cannot be used to reject the claimed invention based on obviousness.

The present invention is directed to a BGA package where a primary substrate and a supplemental substrate having a similar CTE are attached on opposite sides of a metal heat sink plate. As a result of this arrangement, the chip carrier is prevented from warping because the supplemental substrate with the same CTE as the primary substrate is attached to the opposite side of the metal heat sink plate. The bottom side of the chip may then be physically mounted on the metal heat sink plate and not the primary substrate, and the chip is connected to the primary substrate only by wirebond wires (p. 3, line 30-32). Attaching the chip to the metal heat sink plate does not cause a severe CTE mismatch problem because the difference between the CTE of the metal heat sink plate and that of the chip is much less than the difference between the CTE of the chip and the primary substrate. However, since the chip is mounted on the metal heat sink plate and not the primary substrate, the claimed invention is directed to the problem of mismatched CTEs between the primary substrate and the metal heat sink plate and not to the problem of mismatched CTEs between the chip and the substrate.

In contrast, both Johnson and Shishido are directed to problems related to flip-chip packaging, where the top side of the semiconductor chip is electrically and physically attached to a laminated, organic substrate, the primary substrate (Johnson: col. 1, lines 11-13 and lines 18-20, col. 3, lines 27-32, and all of the figures; Shishido: col. 1, lines 11-16, col. 2, line 61 to col. 3, line 6, col. 3, lines 15- 28, and all of the figures). Since the chip and the substrate in Johnson and Shishido are bonded together by solder bumps and underfill, Johnson and Shishido both attempted to solve a different problem, the problem caused by the

mismatch in the CTEs between the chip and the primary substrate (Johnson, col. 1, lines 11-16, and col. 3, lines 33-36; Shishido, col. 1, lines 17-22).

Since Johnson and Shishido are directed to a different type of packaging, the flip-chip packaging instead of the bond-wire packaging as in the present invention, and since Johnson and Shishido endeavored to solve a different problem, the problem of CTE mismatch between the chip and the primary substrate instead of the problem of CTE mismatch between the primary substrate and the metal heat sink plate, Johnson and Shishido are non-analogous prior art to the present invention and cannot be used to reject the present invention based on obviousness.

In *Wang Laboratories, Inc. v. Toshiba Corp*, 993, F.2d. 858, 26 USPQ2d 1767 (Fed. Cir. 1993), patent claims were directed to single in-line memory modules (SIMMs) for installation on a printed circuit motherboard for use in personal computers, while a prior art reference was directed to a SIMM for an industrial controller. Although both the claimed invention and the reference related to memories, and more particularly to SIMMs, the court found that the reference was in a different field of endeavor from the claimed invention because the reference involved memory circuits in which modules of varying sizes might be added or replaced, whereas the claimed invention involved compact modular memories. Furthermore, since memory modules of the claims at issue were intended for personal computers and used dynamic random-access-memories, whereas the reference SIMM was developed for use in large industrial machine controllers and only taught the use of static random access memories or read only memories, the finding that the reference was nonanalogous was supported by substantial evidence.

Second, the structures of Johnson and Shishido are so different that they do not suggest their combination. In addition to the semiconductor chip, Johnson's circuit module includes a substrate 12, an epoxy encapsulant 24 and a heat spreader cap made of two different materials 28 and 29. As stated at col. 4, lines 2-5, the use of different materials permits the CTE of the cap to be adjusted. Since there would be no way to adjust the CTE if the CTEs of the two materials were the same, it is evident that the CTEs of the two materials must be different.

In contrast, Shishido's electronic package comprises an organic substrate 12 (col. 3, line 7) and a heat dissipating structure 30a, 30b made of a metal or metal alloy (col. 3, lines

32-42). Unlike Johnson's structure, the non-chip components of Shishido's package all have substantially the same CTE (col. 3, line 47). Since Shishido teaches a structure in which all the non-chip package components have substantially the same CTE, there is no suggestion in Johnson or Shishido of how Shishido might be combined with Johnson to form a structure in which some of the non-chip components do not have the same CTE.

Third, the Examiner's argument is also flawed because it is based on his subjective effort to piece the references together using the claimed invention as a stencil. It has long been established that obviousness cannot be established by simply combining the elements in the prior art references. There must be some teaching, suggestion, or motivation for the combination found either explicitly or impliedly in the references themselves or in the knowledge generally available to one of ordinary skill in the art. *In re Rouffet*, 149 F.3d 1350, 1357, 47 USPQ2d 1453, 1457-58 (Fed, Cir. 1998) (The combination of the references taught every element of the claimed invention, however without a motivation to combine, a rejection based on a *prima facie* case of obviousness was held improper.) See also *In re Kotzab*, 217 F.3d 1365, 1370, 55 USPQ2d 1313, 1317 (Fec. Cir. 2000); In re Lee, 277 F.3d 1338. 1342-44, 61 USPQ2d 1430, 1433-34 (Fed. Cir. 2002); and *Ex parte Levengood*, 28 USPQ2d 1300 (Bd. Pat. App. & Inter. 1992). In the instant case, the Examiner points to no teaching in either reference that suggests their combination to form the claimed invention. The Examiner also does not present any objective evidence of the level of ordinary skill in the art that suggests their combination. Therefore, the Examiner's argument is one based on hindsight and does not meet the requirement of establishing a prima facie case of obviousness.

Fourth, the Examiner's argument that Johnson and Shishido can be combined is simply wrong. As the Examiner notes in his communication of August 20, 2003, Johnson teaches that the materials 28 and 29 of his cap be different. As noted above, this is to permit adjustment of the CTE, and implies that the CTEs of the two materials be different. Shishido however, teaches that the materials 30a and 30b of his cap 30 have the same CTE as substrate 12. It is respectfully submitted that there is no way to combine Johnson's teaching that the materials 28 and 29 of his cap be different with Shishido's teaching that materials 30a and 30b of his cap have the same CTE.

In addition to the requirement of some suggestion in the prior art for the modification of the prior art to form the invention, there is also the requirement that there must be a

reasonable expectation of success and that the reasonable expectation of success must be found in the prior art and not be based on applicant's disclosure. Accordingly, case law has long established that there is no suggestion of a modification if the proposed modification would render the modified prior art invention unsatisfactory or inoperable for its intended purpose. *In re Gordon*, 733 F. 2d 900, 221 USPQ 1125 (Fed. Cir. 1984), *McGinley v. Franklin Sports, Inc.* 262 F.3d 1339 (Fed. Cir. 2001); *In re Fritch,* 972 F.2d 1260 (Fed. Cir. 1992); *Tec Air, Inc. v. Denso Mfg. Michigan Inc.* 192 F.3d 1353 (Fed. Cir. 1999).

In re Gordon involved the patentability of a blood filter assembly for use during medical procedures wherein both the inlet and outlet for the blood were located at the bottom end of the filter assembly, and wherein a gas vent was present at the top of the filter assembly. A prior art reference taught a liquid strainer for removing dirt and water from gasoline and other light oils wherein the inlet and outlet were at the top of the device, and wherein a pet-cock (stopcock) was located at the bottom of the device for periodically removing the collected dirt and water. The reference further taught that the separation is assisted by gravity. The Board concluded that the claims were prima facie obvious, reasoning that it would have been obvious to turn the reference device upside down. The court reversed, finding that if the prior art device were turned upside down it would be inoperable for its intended purpose because the gasoline to be filtered would be trapped at the top, the water and heavier oils sought to be separated would flow out of the outlet instead of the purified gasoline, and the screen would become clogged.

Similarly, in the instant case, combining Johnson and Shishido by giving the material layer 29 of Johnson the same CTE as the substrate 12 would result in a structure that is unsatisfactory or inoperable for its intended purpose as recited in Johnson (col. 3, lines 38-40 and lines 44-46). Unlike the packaging structure shown in Figure 2 in Shishido in which the substrate 12 and the thermally conductive structure 30a and 30b all have the same CTE, the Johnson structure shown in Figure 6 is made of materials having different CTEs. Specifically heat spreading cap layers 28 and 29 are described at col. 4, lines 3 and 4 as being composed of two different materials. And since one purpose of these different materials as stated in col. 4, line 5, is to permit adjustment of CTE, the CTE of these two materials must be different. The other two materials in the package are the substrate 12 and an epoxy encapsulant 24 which differ from the head spreader cap. Compared to the material layer 29, the substrate 12 is much further away from the material layer 28 and is separated from the material layer 28

by the chip 14 and the encapsulant 24. Thus, if material 29 has the same CTE as the substrate 12, the bending forces on the two opposite sides of the material layer 28 will not be balanced; and Johnson's design for using the two different materials 28 and 29 of the heat spreader cap 22 so they can work together to counter-balance the forces exerted by the thermal mismatch between the chip 14 and the substrate 12 will not be attained. Therefore, without consulting the applicants' disclosure, there would be no reasonable expectation of success in combining the structure of FIG. 6 in Johnson and that of FIG. 2 in Shishido.

Claims 11-14 depend from claim 9 and include further limitations in addition to the limitations in claim 9. Therefore, claims 11-14 are patentable for the same reason claim 9 is patentable.

(b) Claim 10

Claim 10 includes the additional limitation that the supplemental substrate is constructed from the same material as the primary substrate. This limitation is not found in either Johnson or Shishido. Johnson does not disclose that any of the materials in the heat spreader cap 22 be constructed from the same material as the substrate 12. Shishido explicitly states that the substrate 12 is made of an organic material (col. 3, line 7) and the heat dissipating structure 30 is made of metal or metal alloy (col. 3, lines 32-42). Consequently, these structures are of different materials. Since the references do not disclose or suggest a structure in which the primary and secondary substrates are made of the same material, claim 10 is patentable over these references.

Claim 10 is separately patentable because it recites a very specific relationship (identity of material) between the two substrates that has the benefit of simplifying design and fabrication issues.

(c) Claim 20

Claim 20 as amended includes the additional limitation that the primary substrate comprises a hole forming a die-attach cavity wherein the semiconductor chip is attached to the first side of the metal heat sink plate within the die-attach cavity. The Examiner rejected claim 20 based on his rejection of claim 9 and the Hamzehdoost reference, arguing that the Hamzehdoost reference discloses on FIG. 5 a primary substrate 226 comprising a die attach

cavity 206 wherein the semiconductor chip 202 is attached to the first side of a metal heat sink within the die attach cavity. The Examiner's argument is again flawed because FIG. 5 in Hamzehdoost does not disclose a metal heat sink plate and because the chip 202 in FIG. 5 of Hamzehdoost is attached to a package body 204, not to the metal heat sink plate. While the edge of the chip 202 in FIG. 5 of Hamzehdoost is attached to the package body 204, the middle portion on the back of the chip 202 is left exposed through an opening 216 in the package body 204 for direct access to a cooling mechanism (col. 5, lines 1-7). Although Hamzehdoost does disclose in FIG. 8 that a heat sink 300 can be attached to the package body 256 and the back of the chip 252, Hamzehdoost does not teach or suggest attaching a supplemental substrate to the opposite side of the heat sink to prevent a mismatch of the CTE's. Furthermore, Hamzehdoost is not in the same field of endeavor as Johnson and Shishido because the latter are directed to flip-chip packaging while Hamzehdoost is directed to bond-wire packaging. Therefore, one skilled in the art would not be prompted to combine these references from different fields. For these reasons, claim 20 cannot be properly rejected under 35 U.S.C. 103(a) as being unpatentable over Johnson and Shishido and further in view of Hamzehdoost.

(9) Appendix - Claims on Appeal

9. (Previously amended) A semiconductor chip carrier comprising:

a primary substrate;

a metal heat sink plate, whose thermal coefficient of expansion is substantially different from that of said primary substrate, having a first side and an opposing second side where said primary substrate is attached to said first side;

a supplemental substrate being attached to said second side of said metal heat sink plate, wherein said metal heat sink plate is between said primary substrate and said supplemental substrate; and

said supplemental substrate is constructed from a material having a substantially similar coefficient of thermal expansion as that of said primary substrate so that the presence of the supplemental substrate prevents the semiconductor chip carrier from warping.

10. (Original) A semiconductor chip carrier according to claim 9, wherein said supplemental substrate is constructed from a same material as said primary substrate.

11. (Original) A semiconductor chip carrier according to claim 9, wherein said primary substrate is constructed from a material selected from one of Bis-malesimide triazine epoxy, FR4, polyimide, and polytetrafluoroethylene.

12. (Original) A semiconductor chip carrier according to claim 9, wherein said chip carrier is a ball-grid array chip carrier.

13. (Original) A semiconductor chip carrier according to claim 9, wherein said metal heat sink plate consists of a metal selected from one of Cu, Cu-W, Al, and alloys thereof.

14. (Original) A semiconductor chip carrier according to claim 9, wherein said supplemental substrate has a Cu-Ni finish layer.

15. (Original) A semiconductor chip carrier according to claim 9, wherein said supplemental substrate has a cavity exposing a portion of said metal heat sink plate.

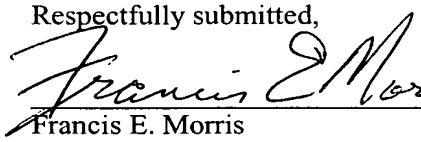
20. (Original) A semiconductor chip carrier according to claim 9, wherein said primary substrate comprises a hole forming a die-attach cavity wherein the semiconductor chip is attached to the first side of the metal heat sink plate within the die-attach cavity.

For the foregoing reasons, the claims on appeal are believed to be patentable and in condition for allowance. Such action is respectfully requested.

The Commissioner is authorized to charge the Appeal fee in the amount of $330.00 and any other all required fees, fees under 37 C.F.R. § 1.17 and all required extension of time fees throughout the pendency of this application, or credit any overpayment, to Morgan, Lewis & Bockius LLP Deposit Account No. 50-0310 order no. 060889-0055-US).

Respectfully submitted,

Date: March 23, 2004



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